METHOD OF AND APPARATUS FOR MIXING OF FLUENT MATERIALS ENCLOSED IN A BAG

FIELD OF THE INVENTION

The present invention relates generally to mixing processes and, more particularly, to a method of and apparatus for mixing fluent material enclosed within a flexible bag or other container.

BACKGROUND OF THE INVENTION

There are innumerable instances where mixing of materials enclosed within some form of container is required. Such materials are, of course, miscible and may be in the form of gases, liquids, granular, particulate, or some other form of fluent materials. As one example with which the present invention is expecially concerned, in the production of mushroom spawn, a small quantity of mycelium is introduced in a much larger quantity of grain and enclosed in a flexible bag where growth can occur. However, to establish a thorough distribution, mixing of the materials within the bag is requisite. Most commonly, such mixing is accomplished by manual manipulation of the flexible bag which, as will be obvious, is a tedious operation that is not only inefficient, but also is not too effective.

SUMMARY OF THE PRESENT INVENTION

Accordingly, it is the general objective of the present invention to provide a method of mixing fluent materials in a bag by effective turning and vibration action of the bag to effect thorough intermixing of the bag contents. Apparatus for automatically carrying out the method by a relatively simple mechanical action constitutes an ancillary objective of the invention.

To achieve such objective, the method involves as a first step the convevance of the bags in spaced sequence along a predetermined path. Preferably such conveyance is achieved by frictional engagement of the bags with a longitudinally vibrating and supporting surface which will effect a shaking of the bags and at the same time a turning thereof in one direction.

Periodically, the conveyed advance of each bag is temporarily blocked by a series of baffles positioned above the moving and supporting surface. During the blocked advance of each bag, vibration and turning thereof continues and contact with the blocking baffle enhances the intermixing of the bag contents.

When a succeeding bag is brought into contact with the blocked bag, the rotation of the succeeding bag effects reverse rotation of the blocked bag, in a manner analgous to the engagement of gears, whereupon the blocked bag can climb over the blocking baffle for subsequent conveyence. The action continues over a series of conveyer sections and baffles so that a complete intermingling of the contents is assured.

In accordance with an ancillary aspect of the invention, the steps of the method are carried out automatically with an apparatus providing for conveyance of the bags along a predetermined path and contact during such conveyance so that turning of the bags and effective mixing of the bag contents are experienced during the conveyance. The conveying member is in the form of an elongated trough which preferably provides frictional contact and conveyance of the bags as a result of vibratory motion such as that shown in U.S. Pat. No. 4,313,535. As there shown and described in detail, the conveying member is mounted by a plurality of beam springs above a frame which is excited for back and forth motion from an attached vibratory drive means.

In accordance with the present invention, the bottom of the conveying trough is composed of a rough surface which advances and turns the bags as they pass successively thereover as a result of the vibratory action. At periodic intervals at least twice as great as the diameter of a single bag, low baffles are mounted to transversely bridge the conveying trough so as to temporarily block the conveyance or advance of an adjacent bag. When a succeeding bag engages the blocked bag, the turning or rotation of the succeeding bag engages the blocked bag so as to effect rotation of it in the opposite direction so that the blocked bag will ride over the low baffle for further conveyance.

Preferably the baffle includes an upright section less than bag diameter and a somewhat resilient section directed opposite to the direction of conveyance and having an undulating, sinusoidal edge wherefore contact with an adjacent bag will effect distribution of the bag contents rearwardly and laterally relative to the general direction of the bag conveyance.

After traverse of the entire length of the conveying member and periodic engagement with the plurality of baffles, a full intermixture of the bag contents is assured.

BRIEF DESCRIPTION OF THE DRAWINGS

The foregoing brief description of the inventive method and apparatus for carrying out the same automatically will be more fully understood by the reference to the following detailed description of the apparatus shown in the accompanying drawings wherein:

FIG. **1** is a side elevational view of an apparatus embodying the invention,

FIG. **2** is an enlarged fragmentary top plan view of a portion of the FIG. **1** apparatus,

FIG. **3** is a transverse sectional view taken along line **3**—**3** of FIG. **2**,

FIG. **4** is a greatly enlarged fragmentary perspective view of a portion of the conveying surface,

FIG. **5** is a perspective view of a flexible bag whose contents are intermixed during operation of the apparatus, and

FIGS. **6A**–**6E** are a series of diagrammatic views showing a sequence of the bag positions during the operation.

DETAILED DESCRIPTION OF THE ILLUSTRATED EMBODIMENT OF THE INVENTION

With initial reference to FIG. **1**, the illustrated apparatus for automatically carrying out the method of the present invention includes an enlongated conveying member **10** in the form of a generally U-shaped trough which is mounted at spaced intervals on both sides at the upper ends of a plurality of beam springs **12**. The beam springs extend upwardly and at a slight rearward angle as discussed in detail in U.S. Pat. No. 4,313,535 to which reference is made for construction and operational details.

Also as described in that Patent, the lower ends of the beam springs **12** are secured to an excited frame **14** mounted at its four corners by resilient legs **16** carried on a supporting floor or other surface. Preferably in the present case, the legs at the entrance end are slightly longer than the legs at the exit end of the apparatus wherefore the excited frame **14** and the conveying